RISK-BASED DECISION-MAKING GUIDELINES

Volume 3
Procedures for Assessing Risks

Applying Risk Assessment Tools

Chapter 6 — Preliminary Risk Analysis (PrRA)

Chapter Contents

This chapter provides a basic overview of the preliminary risk analysis technique and includes fundamental step-by-step instructions for using this methodology to characterize risk associated with significant accident scenarios. The following are the major topics in this chapter:

See examples of preliminary risk analyses in Volume 4 in the Preliminary Risk Analysis (PrRA) directory under Tool-specific Resources.

Preliminary Risk Analysis

Preliminary Risk Analysis									
Activity: Cargo loading/unloading: container									
No.	Accident	Most Significant Contributors	Frequency 1	Frequency 2	Frequency 3	RIN	Certainty	Safeguards	Recommen-dations
1.1	Acute hazard exposure: workers	Dropped objects from cranes Physical injuries during handling operations Slips, trips, or falls during handling operations	3	4	3	1.815	Medium	Personnel qualifications: dock workers Promulgation and enforcement of industry standards: personal protective equipment and safe work practices	Consider establishing crew fatigue guidelines

Summary of Preliminary Risk Analysis

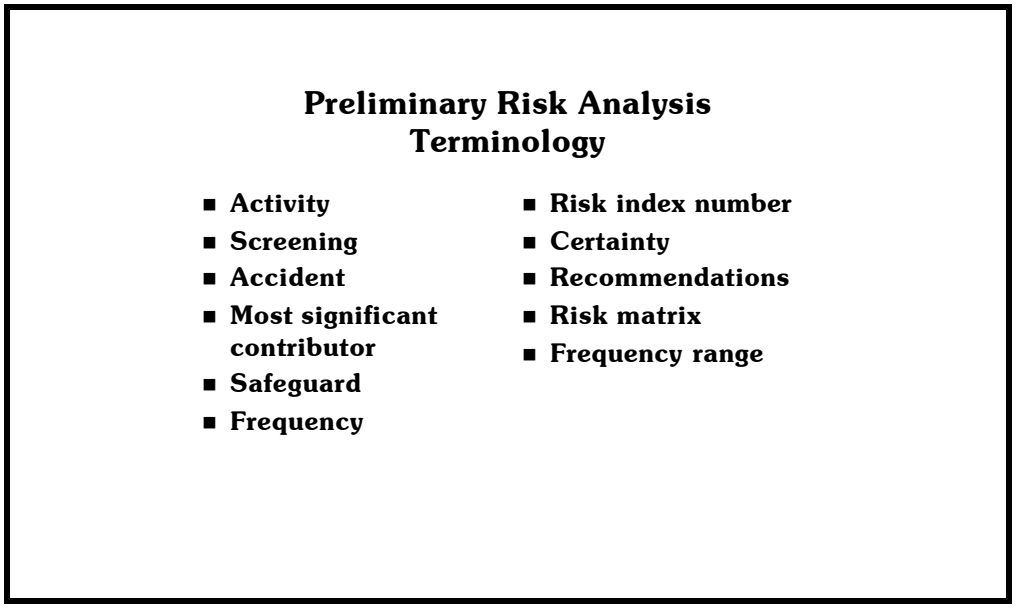
Preliminary risk analysis is a streamlined accident-centered risk assessment approach. The primary objective of the technique is to characterize the risk associated with significant accident scenarios. This team-based approach relies on systematic examination of the issues by subject matter experts and stakeholders. The team postulates combinations of accidents, most significant contributors to accidents, and safeguards. The analysis also characterizes the risk of the accidents and identifies recommendations for reducing risk. The graphic above shows a portion of a worksheet from a preliminary risk analysis.

Brief summary of characteristics

- Systematic approach based on the HAZOP analysis technique developed for the Coast Guard occupational safety and health program
- Analyzes accidents that may occur during normal operations
- Performed using a team of subject matter experts
- An analysis technique that generates
  - qualitative descriptions of potential problems
  - quantitative estimates of risk
  - lists of recommendations for reducing risk
  - quantitative evaluations of recommendation effectiveness

Most common uses

- Used primarily for generating risk profiles across a broad range of activities, such as in a port-wide assessment



Preliminary Risk Analysis Terminology

Definitions

The following terms are commonly used in preliminary risk analysis:

Activity. A collection of tasks or a single task performed in support of an objective

Screening. Determining at a high level that an item is of low risk and will not need to be analyzed in detail

Accident. A mishap or loss

Most significant contributor. A scenario or initiating event (cause) that, if not prevented or mitigated, may result in an accident

Safeguard. Engineered systems (hardware) or administrative controls for (1) reducing the frequency of occurrence of significant contributors or (2) reducing the likelihood or the severity of accidents

Frequency. A score indicating the expected number of occurrences per year of the relevant accident category

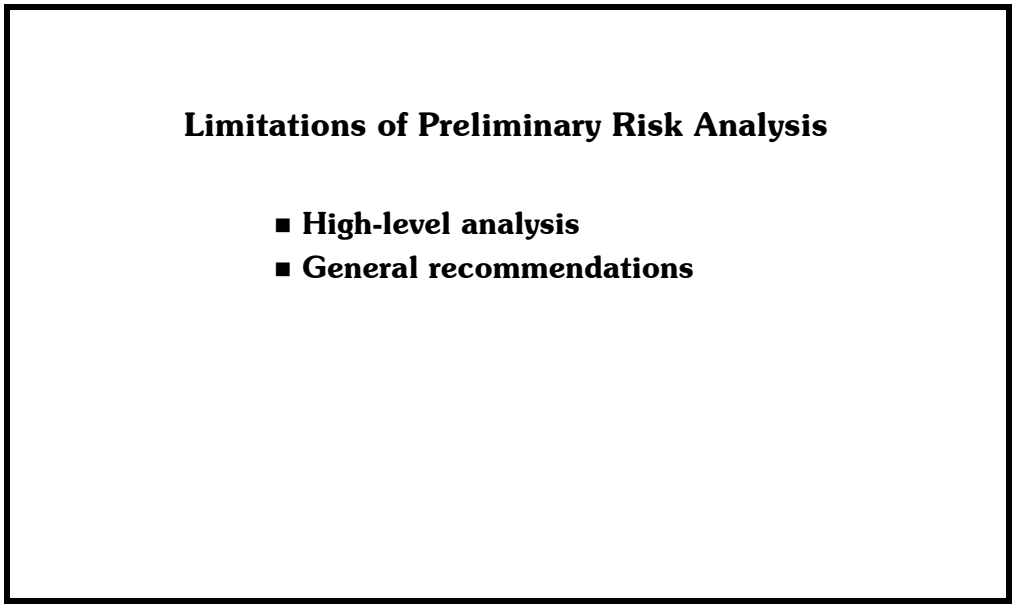
Risk index number (RIN). A relative measure of the overall risk associated with an accident

Certainty. The confidence in the frequency assessments provided by the analysis team

Recommendations. Suggestions for (1) reducing the risk associated with an accident or (2) providing more extensive evaluation of specific issues

Risk matrix. A matrix depicting the risk profile of issues analyzed. Each cell in the matrix indicates the number of accidents having that frequency and consequence.

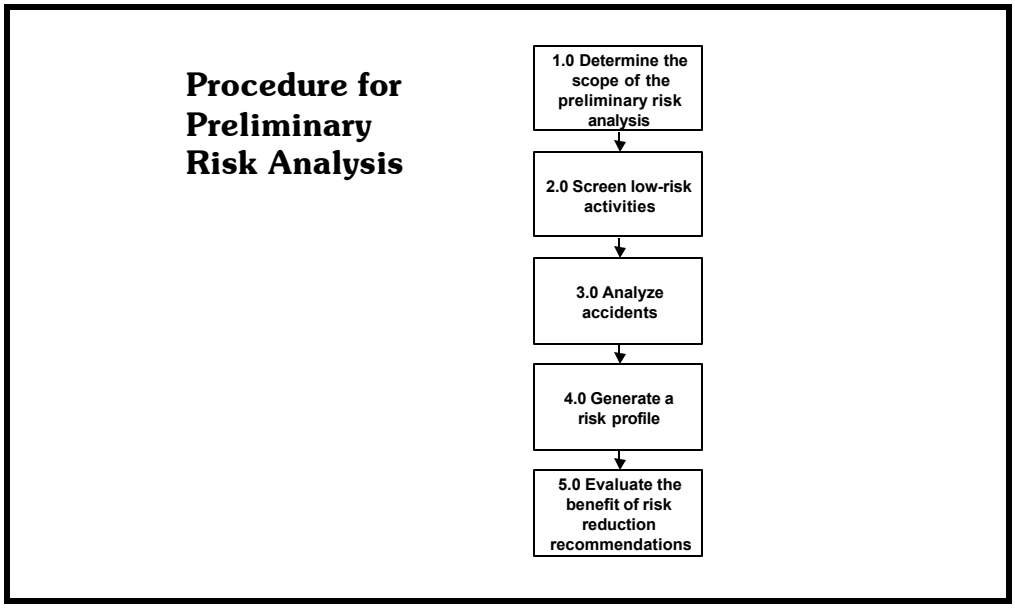
Frequency range. A lower and upper limit representing the estimated frequency of occurrence of an accident category



Limitations of Preliminary Risk Analysis

Although preliminary risk analysis is effective and efficient for identifying high-risk accidents, this tool has two primary limitations:

- **High-level analysis.** The preliminary risk analysis focuses on potential accidents of an activity; therefore, the failures leading to accidents are not explored in much detail. The high-level, general nature of the analysis introduces a level of uncertainty in the results.
- **General recommendations.** One result of the analysis is the development of recommendations for reducing risk. Due to the high-level nature of the analysis, these recommendations are typically general in nature instead of focused on attacking specific issues.



Procedure for Preliminary Risk Analysis

The procedure for performing a preliminary risk analysis consists of the following five steps. Each step is further explained on the following pages. For even more detail on these procedure steps, see the file entitled "Further Information on Preliminary Risk Analysis.pdf," located in the Preliminary Risk Analysis directory under Tool-specific Resources in Volume 4 of these *Guidelines*.

1.0 Determine the scope of the preliminary risk analysis. Determining the scope includes identifying the hazards and activities that will be analyzed.

2.0 Screen low-risk activities. Screening low-risk items streamlines the analysis by eliminating in-depth review of these items.

3.0 Analyze accidents. Evaluating possible accidents, and screening them when appropriate, is the fundamental activity in the preliminary risk analysis. This involves identifying accidents. It also involves identifying the most significant contributors and safeguards, and characterizing the risk associated with the accidents. Recommendations for reducing risk or reducing uncertainty are also developed.

4.0 Generate a risk profile. The risk information generated from the preliminary risk analysis can be sorted and reported in a variety of ways to aid in decision making.

5.0 Evaluate the benefit of risk reduction recommendations. Before a recommendation is implemented, the benefit or risk reduction realized from implementing the recommendation should be calculated and considered.

1.0 Determine the scope of the preliminary risk analysis

- **Activities**
- **Hazards**

1.0 Determine the scope of the preliminary risk analysis

Determining the scope of the analysis involves identifying both the activities of interest that will be reviewed and the hazards that may be present during the performance of each activity.

Activities of interest. Activities of interest may include the following:

- **Cargo transportation: deep draft vessels**
- **Cargo loading/unloading: bulk liquid**
- **Boarding**
- **Damage control**
- **Inspections**

Note: Activities in this section are in bold type.

Hazards. There are hazards associated with each activity. Associating hazards with activities identifies the specific hazards and accidents the analysis team should be considering as an activity is analyzed.

Example

Activity	Hazard
Cargo loading/ unloading: container	Elevated objects
	Tension/compression
	Elevated personnel
	High pressure
	Onboard equipment motion

2.0 Screen low-risk activities

- **Qualitatively review each activity**
- **Determine whether the frequency and severity of accidents are less than or equal to the screening criteria**

2.0 Screen low-risk activities

Screening allows the analysis team to streamline the preliminary risk analysis process by identifying low-risk items and eliminating them from the analysis. Screening is a systematic activity that can be performed at any stage of the process.

The activities identified for the risk assessment should be qualitatively reviewed to determine whether the collective frequency of their accidents in all severity categories is less than or equal to screening criteria. Screening criteria are defined by management systems and are the level of risk that management is unwilling to pursue for further risk assessment.

A screening criteria is a set of frequency scores assigned to each accident severity category used in the analysis (see page 6-17). To perform the screening step, the analysis team qualitatively reviews the activity and decides whether there are any credible accidents that can occur at a frequency higher than the predefined screening criteria for each accident severity category.

Example screening criteria

	Accident Severity Categories		
	Major (1)	**Moderate (2)**	**Minor (3)**
Frequency Scores (equal to or less than)	**2**	**3**	**4**

If the analysis team believes that the activity falls at or below the screening criteria, then the activity is screened from the risk assessment. Otherwise, the activity is included for further evaluation.

3.0 Analyze accidents

- **Identify possible accidents**
- **Identify most significant contributors**
- **Identify safeguards**
- **Determine frequency scores**
- **Calculate RIN**
- **Characterize certainty**
- **Develop recommendations**

3.0 Analyze accidents

Preliminary risk analysis provides a systematic way to analyze accidents that may occur while an activity is performed. For each accident, the analysis identifies both the most significant contributors and the safeguards in place to prevent the contributors or mitigate the accidents. The analysis also defines the risk associated with the accidents as well as recommendations to reduce the risk.

On the next few pages, the meaning and use of the columns from an example preliminary risk analysis worksheet are presented.

3.1 Identify possible accidents of the activity

Preliminary Risk Analysis									
Activity: Cargo loading/unloading: container									
No.	**Accident**	Most Significant Contributors	Frequency 1	2	3	RIN	Certainty	Safeguards	Recommen-dations
1.1	**Acute hazard exposure: workers**	Dropped objects from cranes Physical injuries during handling operations Slips, trips, or falls during handling operations	3	4	3	1.815	Medium	Personnel qualifications: dock workers Promulgation and enforcement of industry standards: personal protective equipment and safe work practices	Consider establishing crew fatigue guidelines

Answer this question when identifying accidents:

"While performing this activity, what are the potential accidents that may occur?"

An accident is any event that can produce a marine casualty of interest.

A suggested set of marine accidents could include the following:

Example Marine Accidents of Interest	
Capsizing	**Drowning**
Collision with another vessel	**Person overboard**
Allision	**Spill of material**
Collision with a floating object	**Acute hazard exposure: workers**
Grounding	**Acute hazard exposure: public**
Sinking	**Nonconformance leading to loss of commerce**
Fire or explosion	

Screen low-risk accidents in this activity

Screening accidents allows the analysis team to streamline the preliminary risk analysis process by identifying low-risk accidents associated with the activity and eliminating them from the analysis. Screening is a systematic activity that can be performed at any stage of the analysis process.

Each accident identified for the activity should be qualitatively reviewed to determine whether its frequency for each accident severity category is less than or equal to the screening criteria. Screening criteria are defined by management systems and are the level of risk that management is unwilling to pursue for further analysis. Example screening criteria are on page 6-11.

3.2 Identify the most significant contributors to accidents

Preliminary Risk Analysis									
Activity: Cargo loading/unloading: container									
No.	Accident	**Most Significant Contributors**	Frequency 1	2	3	RIN	Certainty	Safeguards	Recommen-dations
1.1	Acute hazard exposure: workers	**Dropped objects from cranes** **Physical injuries during handling operations** **Slips, trips, or falls during handling operations**	3	4	3	1.815	Medium	Personnel qualifications: dock workers Promulgation and enforcement of industry standards: personal protective equipment and safe work practices	Consider establishing crew fatigue guidelines

Answer this question when identifying contributors:

"While performing this activity, what are the most significant contributors to this accident?"

Contributors to accidents can include the following:

- Human errors
- Equipment failures
- Hardware system failures
- Administrative system failures

Focus on single events. Include multiple-event contributors only in cases where the frequency of the multiple events is high.

3.3 Identify preventive and mitigative safeguards

Preliminary Risk Analysis									
Activity: Cargo loading/unloading: container									
No.	Accident	Most Significant Contributors	Frequency 1	2	3	RIN	Certainty	**Safeguards**	Recommen-dations
1.1	Acute hazard exposure: workers	Dropped objects from cranes Physical injuries during handling operations Slips, trips, or falls during handling operations	3	4	3	1.815	Medium	**Personnel qualifications: dock workers** **Promulgation and enforcement of industry standards: personal protective equipment and safe work practices**	Consider establishing crew fatigue guidelines

Answer this question when identifying safeguards:

"While performing this activity, what are the engineered systems or administrative controls in place to reduce the frequency of the contributors or reduce the severity of the accident?"

Types of safeguards to consider:

- Hardware (e.g., barriers, alarms, interlocks, redundant pumps)
- Specific procedures and training (e.g., ammunition loading procedure, PQS for deckcrew)
- Specific administrative policies (e.g., respiratory protection)

3.4 Determine the frequency of the accident resulting in defined levels of severity

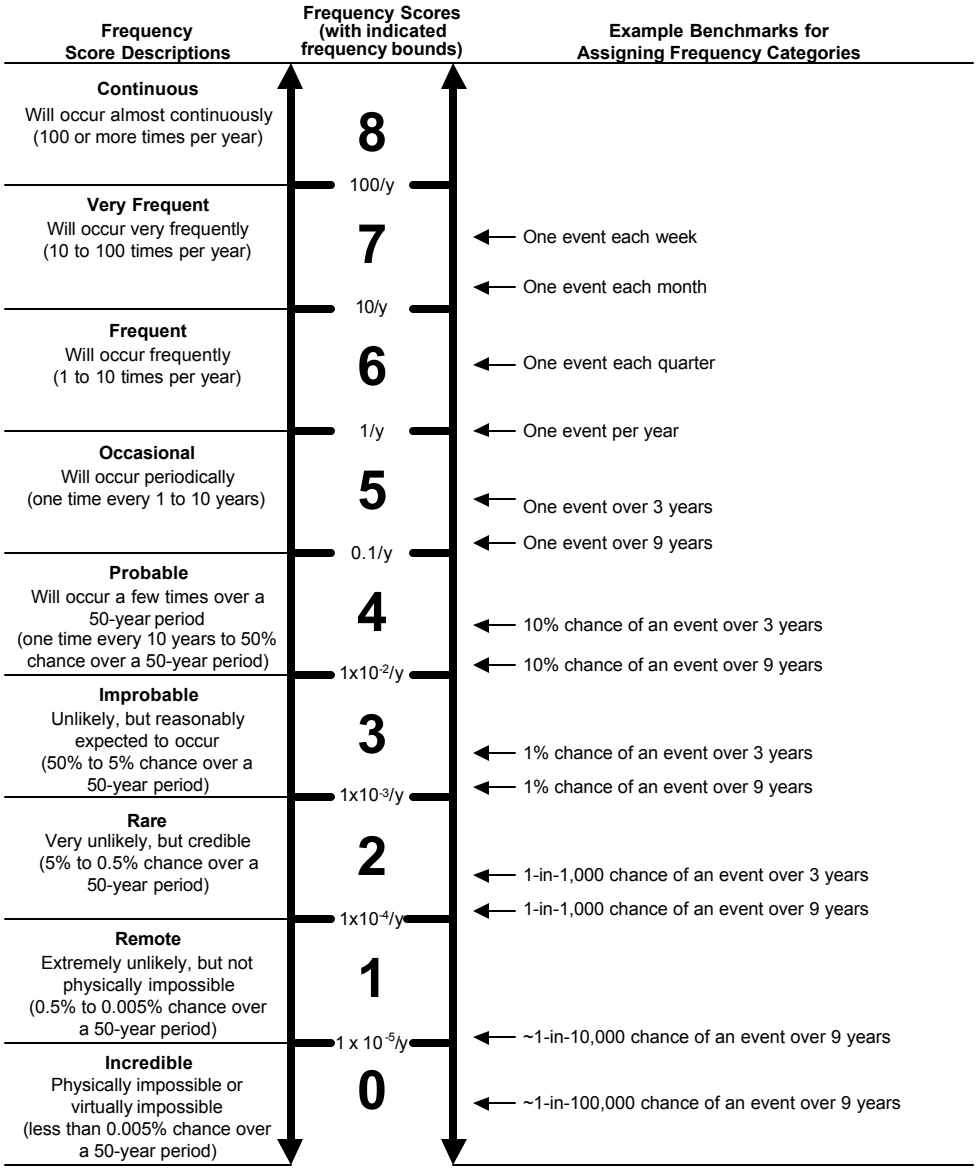
Preliminary Risk Analysis									
Activity: Cargo loading/unloading: container									
No.	Accident	Most Significant Contributors	Frequency 1	2	3	RIN	Certainty	Safeguards	Recommen-dations
1.1	Acute hazard exposure: workers	Dropped objects from cranes Physical injuries during handling operations Slips, trips, or falls during handling operations	3	4	3	1.815	Medium	Personnel qualifications: dock workers Promulgation and enforcement of industry standards: personal protective equipment and safe work practices	Consider establishing crew fatigue guidelines

Using the figure and table on the next page, assess the frequency of each accident occurring and resulting in a major, moderate, or minor severity. Assess the accident only with respect to the activity being considered. Rather than estimating the frequency of each credible accident's contributors occurring and each associated safeguard failing, make higher-level, subjective assessments of the overall frequency of each accident occurring and resulting in a specific severity level. Each frequency estimate should be based on cumulative frequencies of contributing events.

Tip: Use available data from the following sources to develop reasonable frequency estimates:

- Accident database
- Maintenance database
- Subject matter expert judgment
- Generic or vendor data

Example Frequency Scoring Categories



Example Types of Effects*				
Severity	**Safety Impact**	**Environmental Impact**	**Economic Impact**	**Mission Impact**
Major (1)	One or more deaths or permanent disability	Releases that result in long-term disruption of the ecosystem or long-term exposure to chronic health risks	≥ $3M	≥ $3M
Moderate (2)	Injury that requires hospitalization or lost work days	Releases that result in short-term disruption of the ecosystem	≥$10K and <$3M	≥$10K and <$3M
Minor (3)	Injury that requires first aid	Pollution with minimal acute environmental or public health impact	≥ $100 and <$10K	≥ $100 and <$10K

* Losses in these categories result from both immediate and long-term effects (e.g., considering both acute and chronic effects when evaluating safety and health).

3.5 Calculate the risk index number (RIN)

Preliminary Risk Analysis									
Activity: Cargo loading/unloading: container									
			Frequency						
No.	Accident	Most Significant Contributors	1	2	3	RIN	Certainty	Safeguards	Recommen-dations
1.1	Acute hazard exposure: workers	Dropped objects from cranes Physical injuries during handling operations Slips, trips, or falls during handling operations	3	4	3	**1.815**	Medium	Personnel qualifications: dock workers Promulgation and enforcement of industry standards: personal protective equipment and safe work practices	Consider establishing crew fatigue guidelines

Calculate the average risk index number (RIN) for each accident by using the following equation:

$$\mathbf{RIN = [(F \times C)_{Accident\ Category\ 1} + (F \times C)_{Accident\ Category\ 2} + (F \times C)_{Accident\ Category\ 3} + ...] / 10{,}000}$$

Where:

F = the average frequency for the accident (events per year)
C = the average consequence for the accident (dollars per event)

Usually, representative values for each of the accident severity categories are defined prior to the analysis. These values can be defined based on historical information or simply defined as the midpoint of each accident severity range. Likewise, the representative frequency for each of the frequency scoring categories is usually set as the midpoint between the upper and lower bounds of the frequency scoring category.

In this example, there were three accident severity categories, and the average consequence for a major accident was defined as equivalent to $3,000,000, a moderate accident was defined as equivalent to $30,000, and a minor accident was defined as equivalent to $300. The frequency scores determined during the analysis for the three accident severity categories in this example were 3, 4, and 3, respectively. In this case, the representative frequency score is the midpoint of the given frequency category range. Using the figure on the previous page, the average frequency for a frequency score of 3 is 5.5×10^{-3} events/year. The representative frequency for a frequency score of 4 is 5.5×10^{-2}/year. Plugging these average values into the RIN equation above yields an average RIN for the accident of 1.815.

NOTE: The RIN is proportional to the expected equivalent loss in dollars per year loss. An index number of 10,000 was chosen in this example for convenience to present RINs with magnitudes between 1 and 10. Any index number (or no index number) can be used to present the risk.

While analyzing accidents, the average RIN is the only calculation necessary to quantify and compare risks. However, the lower and upper bounds of the risk index number can also be calculated using the lower and upper bounds of each severity and frequency category. This information is useful for reviewing the entire range of risk associated with an accident.

3.6 Characterize the certainty of the frequency estimate

Preliminary Risk Analysis									
Activity: Cargo loading/unloading: container									
No.	Accident	Most Significant Contributors	Frequency 1	2	3	RIN	**Certainty**	Safeguards	Recommen-dations
1.1	Acute hazard exposure: workers	Dropped objects from cranes Physical injuries during handling operations Slips, trips, or falls during handling operations	3	4	3	1.815	**Medium**	Personnel qualifications: dock workers Promulgation and enforcement of industry standards: personal protective equipment and safe work practices	Consider establishing crew fatigue guidelines

Characterize the confidence in the assessment of the frequency scores for each accident. This subjective rating helps to qualify the risk estimates. For example, a medium-risk accident with a High certainty may deserve the same or more attention than a high-risk accident with a Low certainty.

Certainty categories

High — Very confident that the actual frequency is at or below the assigned frequency category, and data exist to support the frequency category

Medium — Confident that the actual frequency is at or below the assigned frequency category, and expect data could be obtained to support the frequency category

Low — Little confidence that the actual frequency is at or below the assigned frequency category, and unsure whether data exist to support the frequency category

3.7 Develop recommendations

Preliminary Risk Analysis									
Activity: Cargo loading/unloading: container									
No.	Accident	Most Significant Contributors	Frequency 1	2	3	RIN	Certainty	Safeguards	**Recommen-dations**
1.1	Acute hazard exposure: workers	Dropped objects from cranes Physical injuries during handling operations Slips, trips, or falls during handling operations	3	4	3	1.815	Medium	Personnel qualifications: dock workers Promulgation and enforcement of industry standards: personal protective equipment and safe work practices	**Consider establishing crew fatigue guidelines**

Risk reduction recommendations, and recommendations suggesting more in-depth review, are necessary for high-risk accidents or accidents with low levels of certainty.

Risk reduction recommendations should accomplish one or more of the following:

- Eliminate or mitigate hazards
- Prevent causes (most significant contributors)
- Ensure that existing safeguards are dependable
- Provide additional safeguards
- Mitigate the effects of accidents

Example

- Consider providing fixed-fire protection for the pumping station
- Consider providing machine guards for the cable/spool pinch-points on the pier winches

Some accidents or issues may require a more detailed analysis. Such situations include:

- High-risk accidents and issues where more resolution is needed to develop risk reduction measures
- Potentially significant accidents and issues with a low level of certainty in the risk assessment or the information gathered about the accident scenario

Examples

Situation 1 — Consider performing more detailed hazard evaluation of the equipment and procedures used for lifting containers to ensure that existing procedures and equipment configurations and preventive maintenance (1) provide adequate protection against dropping loads and (2) are consistent with good engineering practices.

Situation 2 — Consider performing a more detailed analysis of the electrical systems on Pier 14 to specifically identify and evaluate (1) the potential for electrical fires and (2) the potential for electrical shocks of dock workers.

4.0 Generate a risk profile

- **Risk contributions**
- **Risk matrix**
- **Expected number of accidents**

4.0 Generate a risk profile

To manage risk effectively, decision makers must analyze the risk associated with a unit class or facility from several perspectives. The preliminary risk analysis provides risk information for each accident associated with an activity. Risk associated with each accident is the basic information required to analyze overall risk and to generate a risk profile for the subject of the analysis.

The information on the following three pages includes samples of the types of risk information that can be generated from the preliminary risk analysis data.

Risk contributions

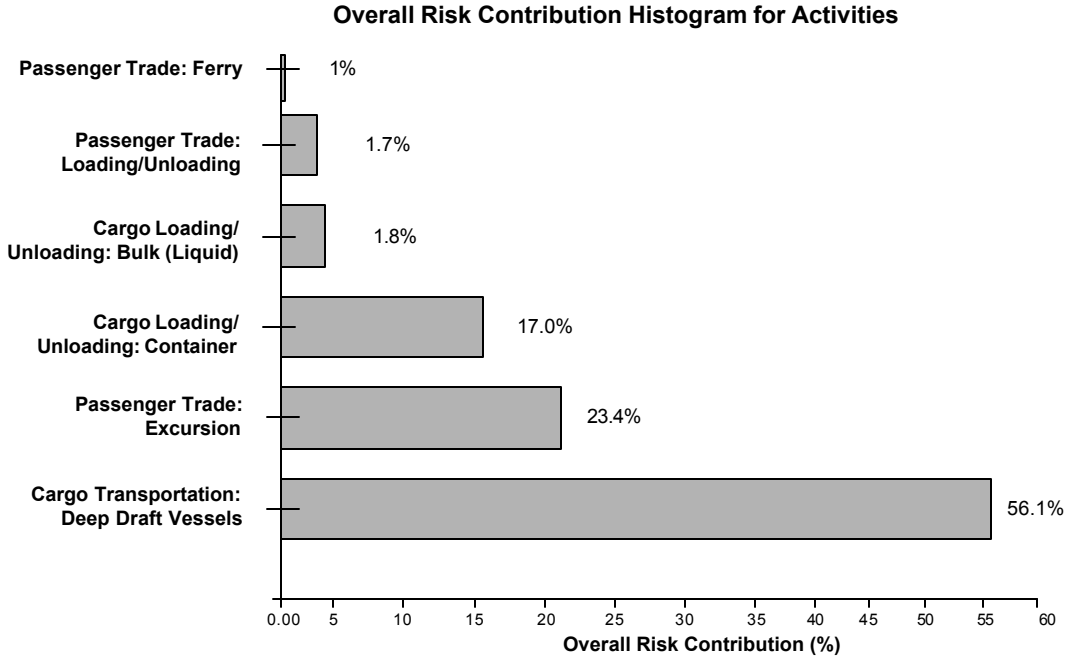
Determining the risk contribution of accidents provides a means to focus resources as narrowly as possible on accidents that are estimated to be the dominant risk contributors. The table and chart that follow are examples of risk contribution data.

Example

Overall Problems Ranked by Risk Contribution	
Activity Deviation	**Risk Contribution**
Cargo transportation: Deep draft vessels Acute hazard exposure: worker	15%
Cargo loading/unloading: Container Acute hazard exposure: worker	15%
Cargo transportation: Deep draft vessels Nonconformance leading to loss of commerce	14%
Passenger trade: Excursion Person overboard	7%

A histogram provides a graphical ranking of the activities, displaying each activity's overall contribution to overall risk.

Example



Risk matrix

This risk matrix illustrates the distribution of accidents according to their frequency of major, moderate, or minor severity categories. The matrix is a valuable risk communication tool and helps decision makers understand how many accidents fall into the various categories.

	Major (1)	Moderate (2)	Minor (3)
Continuous (8)	0	0	0
Very frequent (7)	0	2	2
Frequent (6)	0	5	5
Occasional (5)	1	9	9
Probable (4)	2	15	22
Improbable (3)	6	14	14
Rare (2)	11	17	10
Remote (1)	36	20	3
Incredible (0)	9	4	0

Number of Accidents

Expected number of accidents

This information shows the prediction of how many accidents will occur over the next year. The number is expressed as a range for each accident severity category. The range is a result of summing the upper and lower frequency scores selected for each accident severity category during the analysis.

	Expected Number of Accidents over the Next Year			Expected Number of Occurrences over 50 Years		
Facility	Major (1)	Moderate (2)	Minor (3)	Major (1)	Moderate (2)	Minor (3)
1	0.13 to 1.3	1.4 to 14	26 to 261	7 to 65	70 to 700	1,300 or more

5.0 Evaluate the benefit of risk reduction recommendations

- **Determine revised frequency scores and RINs**
- **Determine the benefit of implementing recommendations**

5.0 Evaluate the benefit of risk reduction recommendations

Each recommendation from the preliminary risk analysis is designed to reduce the risk associated with the accidents discussed during the analysis. These recommendations may serve as preventive or mitigative safeguards, and they may apply to more than one accident.

This section provides a means to estimate the annual dollar savings due to the reduced risk realized by implementing recommendations. The dollar savings can be compared to the implementation cost of the recommendation in a benefit-cost analysis. Decision makers will use this benefit-cost analysis to decide if a recommendation should be implemented.

Determine the revised frequency scores and RINs

The benefit of implementing each preliminary risk analysis recommendation is estimated by determining the potential reduction in frequency scores of accidents affected by the recommendations. This is accomplished by identifying the accidents associated with each recommendation and the accidents' frequency scores. For each frequency score, an estimate is made as to how the score will change if the recommendation is implemented.

Example

Preliminary Risk Analysis Recommendations	Associated Accidents	Initial Frequencies	Revised Frequencies	Certainty in Revised Frequencies	Notes
Recommendation 1- Consider establishing worker fatigue guidelines	**Cargo loading/ unloading: Container** Acute hazard exposure: worker	3, 4, 3	1, 2, 3	Med	
	Cargo loading/ unloading: Bulk (liquid) Acute hazard exposure: worker	2, 4, 5	2, 4, 5	High	No significant risk reduction expected
Recommendation 2- Consider further automation of the loading/unloading operations	**Cargo loading/ unloading: Container** Acute hazard exposure: worker	1, 3, 6	2, 3, 4	Low	
	Cargo loading/ unloading: Bulk (liquid) Acute hazard exposure: worker	2, 4, 5	1, 3, 4	Med	

Determine the benefit of implementing recommendations

The potential benefit gained from implementing a recommendation can be calculated by determining the change in the risk index numbers for the accidents affected by the recommendations.

Multiplying the RIN by 10,000 results in risk values stated in terms of **potential** dollar savings on a yearly basis.

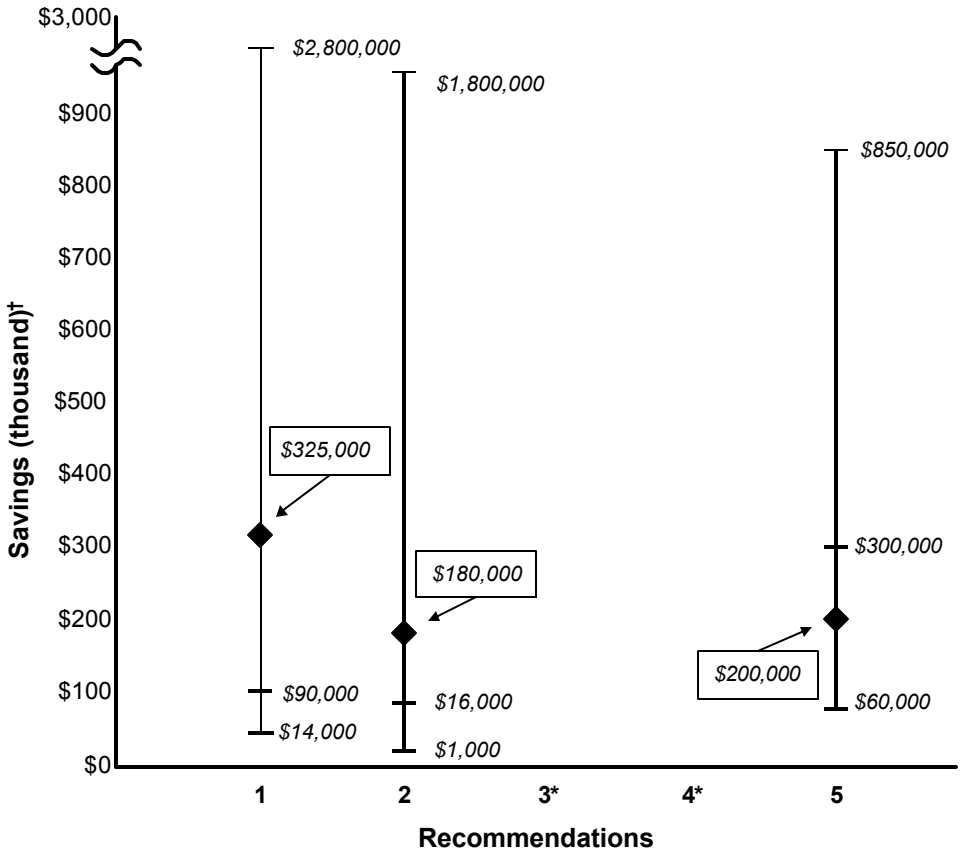
Recommendation	Accidents	Baseline Average RIN	Revised Average RIN	Change in Average RIN	Average Risk Reduction ($/year)
1	1	1.815	0.0183	1.797	17,970
	2	0.3465	0.3465		
	Total	2.1615	0.3648		
2	1	0.198	0.1832	0.3266	3,266
	2	0.3465	0.0347		
	Total	0.5445	0.2179		

Recommendation	Accidents	Baseline Lower RIN	Revised Lower RIN	Change in Lower RIN	Lower Risk Reduction ($/year)
1	1	0.2800	.0028	0.2772	2,772
	2	0.038	0.038		
	Total	0.318	0.0408		
2	1	0.0137	0.0281	0.0198	198
	2	0.038	0.0038		
	Total	0.0517	0.0319		

Recommendation	Accidents	Baseline Upper RIN	Revised Upper RIN	Change in Upper RIN	Upper Risk Reduction ($/year)
1	1	57.01	0.58	56.43	564,300
	2	31	31		
	Total	88.01	31.58		
2	1	13	5.8	35.1	351,000
	2	31	3.1		
	Total	44	8.9		

The estimated range of dollar savings for each recommendation can be compared in several ways (see graph below). The comparison allows decision makers to decide which recommendations should be implemented and in what order. In the graph, savings are represented over a five-year period by multiplying the savings calculated in the step on the previous page by 5. Any period of time can be chosen. The cost of implementing the recommendation can be included, as below, to assist decision makers in deciding whether to proceed with implementation or not.

Displaying all recommendations together allows comparison so that resources can be spent on the most effective ones first.



* A reasonable estimate of savings is possible only after further review.
† Upper, lower, and average savings.
◆ Estimated total cost of implementing recommendation.

Note: Savings shown account for five-year period.

An Alternative Method for Conducting a Preliminary Risk Analysis

To counter some of the general weaknesses of the PrRA, a more systematic technique can be applied. This technique is sometimes referred to as a coarse risk analysis and is a type of PrRA. Further details on this method are found in the Integrated Risk Assessment (IRA) manual sponsored by G-WKS.

Deviation-based versus accident-based. The hierarchy developed for a conventional PrRA can be further broken down into individual deviations, or off-normal conditions that can result in an accident. Instead of evaluating the accidents associated with a particular segment of the hierarchy, the deviations that cause accidents are themselves evaluated. The accidents initiated by the deviations can then be listed, as can the actual causes of the deviations and the safeguards in place to prevent them. This more systematic approach can help to reduce some of the uncertainty in the analysis.

More focused recommendations. The recommendations generated from this type of analysis are designed to prevent specific deviations from occurring and have more precise descriptions. These focused recommendations are also easier to evaluate from a benefit-cost perspective.

Coarse Risk Analysis of Port of Baltimore										
Operation: Cargo loading/unloading: Container										
Function: *Operating lifting equipment*										
				Freq.						
No.	Deviation	Causes	Accidents	1	2	3	RIN	Certainty	Safeguards	Recommen-dations
1.1	Physical hazards exposure	Dropped objects from cranes Physical injuries during handling operations Slips, trips, or falls during handling operations	Hazardous exposure: contact injury	3	4	3	1.815	Medium	Personnel qualifications: dock workers Promulgations and enforcement of industry standards: personal protective equipment and safe work practices	Consider establishing crew fatigue guidelines

Definitions unique to this alternative method

Operation. A specific operational mode of an activity or issue under consideration

Function. A distinct activity that supports one or more operations

Deviation. An off-normal condition or situation that, if not mitigated, may result in one or more accidents

Accident. A result of an unmitigated deviation; a mishap or loss

Cause. An event that, if not prevented, results in a deviation

Limitations of this alternative technique

This technique is an excellent tool for understanding and comparing risk across an organization. However, it does have three main limitations:

Broad focus. This technique is designed to provide information to meet 60% to 90% of an organization's risk-based decision-making needs, hence the name coarse risk analysis. Even though this technique is more detailed than PrRA, there are some instances when the risk characterization data generated during a coarse risk analysis do not present the necessary detail to make some decisions. In these cases, a more detailed risk assessment tool should be used to reduce the uncertainty of the risk characterization and generate greater resolution of the data to make a *good* decision.

Time consuming. This technique systematically reviews credible deviations, investigates engineering and administrative controls to protect against the deviations, and generates recommendations for system improvements. The analysis process requires a substantial commitment of time both from the facilitator and from other subject matter experts, such as crew members, engineering, equipment vendors, etc.

Focuses on one-event causes of deviations. This technique focuses on identifying single failures that can result in accidents of interest. If the objective of the analysis is to identify all combinations of events that can lead to accidents of interest, more detailed techniques such as fault tree analysis (Chapter 11) should be used.

Steps for performing this alternative technique

The procedure for performing this analysis includes the following five steps.

1. **Determine the scope of the coarse risk analysis**. Determining the scope includes identifying the hazards, accidents, operations, and functions that will be analyzed.
2. **Screen low-risk operations, functions, and deviations**. Screening items streamlines the analysis by eliminating in-depth review of low-risk items.
3. **Analyze deviations**. Evaluating deviations is the fundamental activity in the coarse risk analysis. This involves identifying accidents, causes, and safeguards, and characterizing the risk associated with the deviation. Recommendations for reducing risk or uncertainty are also developed.
4. **Generate a risk profile**. The risk information generated from the coarse risk analysis can be sorted and reported in a variety of ways to aid in decision making.
5. **Evaluate the benefit of risk reduction recommendations**. Before a recommendation is implemented, the benefit or risk reduction gained from implementing the recommendation should be calculated and considered.